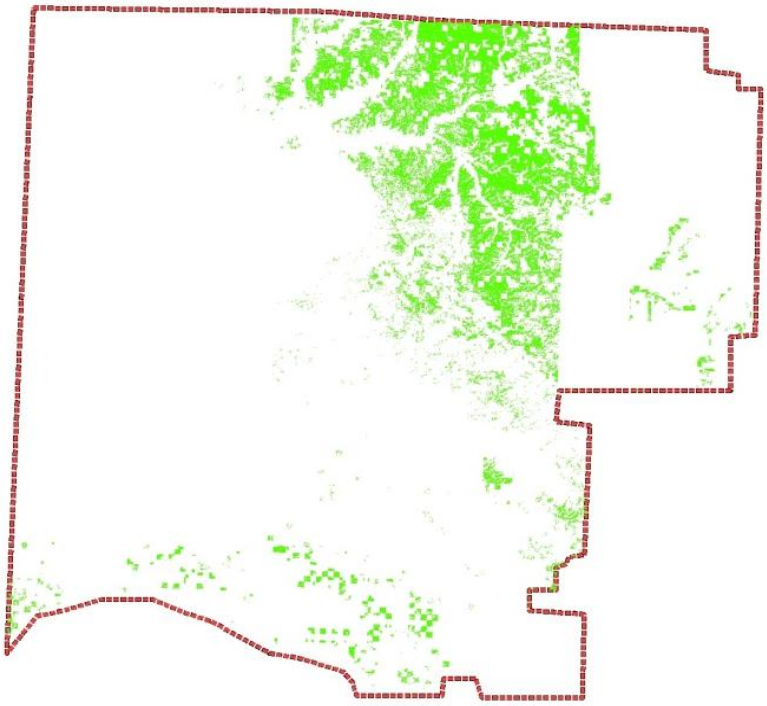
PINYON-JUNIPER COMMUNITY

Farmington Field Office (FFO) lies within the southern end of the Colorado Plateau and manages approximately 1.4 million acres of surface lands (Map 1). Climate in the field office is characterized by cool, dry winters and warm dry summers. The Colorado Plateau (especially the southern portion), receives small peaks of precipitation in both winter and summer. Extremes in topographic relief exist in the field office area, including areas of broad mesas interspersed with many deep canyons with steep canyon walls, dry washes, entrenched narrow valleys, and alluvial fans and flood plains, extending on both side of the Continental Divide. Elevations range from 4,800 feet to 8,800 feet. Ecological Site Descriptions (NRCS) based on soils, precipitation, and elevations for the Colorado Plateau were utilized in this section for potential vegetation and dynamics of those communities, along with various peer reviewed documents. Typical vegetation community type photos are attached (see Figure 1 & 2).



Map 1. Pinyon-Juniper community on BLM lands within the FFO area.

Pinyon–juniper woodlands comprise approximately 638,884 acres (45.6%) of the Farmington Field Office. Pinyon dominate at higher elevations, and tend to form more closed-canopied stands that exhibit forest like dynamics and species composition, commonly including a significant shrub component of oaks and alder leaf, mountain mahogany and limited grasses. Juniper tends to grow at lower elevations and in more arid areas as its scaled foliage allows it to conserve water more effectively than pinyon pine. Historical occurrence of pinyon and juniper is difficult to map, but pre-settlement trees are generally located in shallow, rocky soils and tend to have a unique growth form characterized by rounded, spreading canopies; large basal branches; large irregular trunks; and furrowed fibrous bark (Miller and Rose 1999).

Soils are similarly variable, ranging from relatively deep soils often high in clay or sand content, to shallow rocky soils, to rock outcrops where no soil is present, but the trees are rooted in deep cracks of the bedrock. Woodlands of pinyon or juniper or both occupy a broad zone of intermediate moisture and temperature conditions between the hot arid deserts of lower elevations and the cool mesic forests of higher elevations.

Pinyon–juniper vegetation has been identified three fundamentally different groupings (Romme et al. 2009) based primarily on canopy structure, understory characteristics, and historical disturbance regimes. The three categories are persistent pinyon –juniper woodlands, pinyon–juniper savannas, and wooded shrublands. Farmington Field Office has two general pinyon-juniper vegetation types as described by Romme et al (2009) as Persistent Woodlands and Wooded Shrublands by our precipitation patterns and geographic location. Savannah communities in the Four Corners region and the Colorado Plateau are relatively rare. They are found in central and southern New Mexico and Arizona, where rainfall patterns support extensive grasslands. See Descriptions below for those found in FFO boundaries:

Vegetation Type and Characteristics Description

Persistent pinyon–juniper woodlands (shallow, rocky soils)

Canopy: Ranging from sparse stands of scattered, small trees growing on poor substrates to relatively dense stands of large trees on more productive sites. The canopy may be dominated by either pinyon or juniper or both.

Understory: Variable cover of shrubs, subshrubs, forbs, and grasses, but often sparse, with extensive areas of litter (beneath canopies) and bare soil or rock (intercanopy).

Site conditions: Associated with a wide variety of substrates and topographic settings but most commonly found on rugged uplands with shallow, coarse-textured, and often rocky soils that support relatively sparse herbaceous cover; site conditions (soils and climate) and disturbance regimes (notably infrequent fire) are inherently favorable for tree growth.

Regional distribution: Found in appropriate upland locations throughout the West. Persistent woodlands appear to be especially prevalent on portions of the Colorado Plateau, where precipitation is bimodal, with small peaks in winter and summer.

Wooded shrublands (deeper soils)

Canopy: Variable tree component that may range from very sparse to relatively dense and may include any of the pinyon and juniper species that occur within this vegetation type; however, one-seed juniper and alligator juniper are more commonly associated with persistent woodlands and savannas.

Understory: Well-developed shrub stratum with variable grass–forb cover and composition; shrubs constitute the underlying biotic community in these ecosystems.

Site conditions: Associated with a wide variety of substrates and topographic settings, including shallow, rocky soils on mountain slopes to deep soils of intermontane valleys; site conditions are

inherently favorable for shrub growth; thus, the tree component naturally waxes and wanes over time in response to a variety of climatic and disturbance factors (‘‘areas of potential expansion and contraction’’ in Romme et al. 2007).

Regional distribution: Especially prevalent in the Great Basin, where the precipitation pattern is winter dominated and big sagebrush is a dominant shrub species; however, wooded shrublands can be found throughout the West, where local substrates favor shrub dominance.

Species Composition in the Pinyon-Juniper Woodlands for Farmington Field Office
Colorado pinyon and Utah juniper are the dominant woodland species across most of the within Farmington Field Office (FFO). Rocky Mountain juniper is common at higher elevations in FFO. These woodland trees are typically associated with a major shrub component, notably big sagebrush (several subspecies) and other sagebrush species, antelope bitterbrush, various rabbitbrush species , and. There is a mix of warm and cool season grass species, mostly bunch grass species within varying elevations of pinyon-juniper communities. Perennial bunch grass in the lower elevation pinyon-juniper communities may include Indian ricegrass, blue grama, mutton grass, bottlebrush squirreltail, and needleandthread grass.

At higher elevations or north facing aspects other shrubs and trees present are Gambel’s oak, Rocky Mountain juniper, Utah serviceberry, alderleaf mountain mahogany skunkbush, and black sagebrush. Common bunch grasses present at this transition zone between pinyon-juniper woodland (typically dominated by pinyon) and ponderosa pine are muttongrass, prairie Junegrass, bottlebrush squirreltail, western wheat, (in moister sites in heavier soils), and blue grama.

Dynamics in Pinyon-Juniper Woodlands
In many pinyon and juniper woodlands, stand dynamics are driven more by climatic fluctuation, insects, and disease than by fire. For example, a widespread and severe pinyon mortality event occurred in 2002–2004 in the Four Corners region (Colorado, Arizona, New Mexico, and Utah) as a result of drought, high temperatures, and bark beetle outbreaks.

Spreading, low-intensity, surface fires had a very limited role in molding stand structure and dynamics of many or most pinyon and juniper woodlands in the historical landscape. Historical fire rotations (i.e., the time required for the cumulative area burned to equal the size of the entire area of interest) and fire intervals, at the stand level, varied from place to place in pinyon and juniper woodlands but, in many places, were very long (generally measured in centuries). Recent, large, severe (stand-replacing) fires in pinyon and juniper woodlands are, for the most part, similar to fires that occurred historically.

Tree density and canopy coverage have increased substantially during the past 150 years in many pinyon and juniper woodlands but have not changed or have declined in others. Former grasslands and shrublands in some regions have also been converted to savanna or woodland as trees have expanded into previously non-woodland sites, but expansion has been less common or nearly lacking in other regions. The mechanisms underlying increasing tree density in existing pinyon and juniper woodlands and the expansion of pinyon and juniper into grasslands and shrublands are not well understood in most situations. Possible mechanisms include recovery

from past, severe disturbance; natural, ongoing, Holocene range expansion; livestock grazing; fire exclusion; and effects of climatic variability and rising atmospheric CO2. (A synthesis on Pinyon-Juniper vegetation type Romme et al 2009).

Table 1. Reclamation Goal for Pinyon-Juniper Community Cover–Persistent (shallow, rocky soil)

Functional Group	*Percent (%) Foliar Cover*	*Common Species*
Trees/Shrubs/Grasses/Forbs	≥20	Utah juniper, pinyon pine; Utah serviceberry, alderleaf mountain mahogany, rubber rabbitbrush, cliff fendlerbush, big sagebrush, Antelope bitterbrush, green jointfir, Bigelow sagebrush, broom snakeweed, black sagebrush, Indian ricegrass, blue grama, bottlebrush squirreltail, muttongrass, needle-and-thread grass, sand dropseed, threeawn grass, prairie Junegrass, Arizona fescue, western wheatgrass, Wright's birdbeak, Eriogonum spp., hairy false goldenaster, pingue rubberweed, multi-lobed Senecio, scarlet globemallow, Penstemon spp., Wyoming paint brush, machaeranthera spp.
Invasive/undesirables **10% allowed toward meeting standard of 20%.**	≤10	Plants that have the potential to become a dominant species on a site where its presence is a detriment to revegetation efforts or the native plant community. Examples of invasive species include cheatgrass, Russian thistle, kochia.

Table 2. Reclamation Goal for Pinyon-Juniper Community Cover–Wooded shrubland (Deep soil)**

Functional Group	*Percent (%) Foliar Cover*	*Common Species*
Trees/Shrubs/Grasses/Forbs	≥20	Utah juniper, pinyon pine; big sagebrush, four-wing saltbush , Antelope bitterbrush, rubber rabbitbrush,, broom snakeweed, bottlebrush squirreltail, , western wheatgrass, Indian ricegrass, galleta, sand dropseed, threeawn grass, scarlet globemallow, wooly Indianwheat, fleabane spp., Penstemon spp., buckwheat spp., threadleaf groundsel
Invasive/undesirables **10% allowed toward meeting standard of 20%.**	≤10	Plants that have the potential to become a dominant species on a site where its presence is a detriment to revegetation efforts or the native plant community. Examples of invasive species include cheatgrass, Russian thistle, kochia.

Table 3. Menu based seed mix by habitat type for reclamation for pinyon-juniper community (minimum requirement)**

Common Name	*Scientific Names*	*Variety*	*Season*	*Form*	*PLS lbs/acre**
Plant one of the following:					
Mountain mahogany	*Cercocarpus montanus*	VNS	Warm	Shrub	2.0
Antelope bitterbrush	*Purshia tridentata*	VNS	Cool	Shrub	2.0

And two of the following:					
Western wheatgrass	*Pascopyrum smithii*	Arriba	Cool	Sod	2.0
Bottlebrush squirreltail	*Elymus elymoides*	Tusas or VNS	Cool	Bunch	3.0
Needleandthread	*Hesperostipa comata*	VNS	Cool	Bunch	3.0
And three of the following:					
Indian ricegrass	*Achnatherum hymenoides*	Paloma or Rimrock	Warm	Bunch	3.5
Blue grama	*Bouteloua gracilis*	Alma or Hachita	Warm	Bunch	2.0
Sand dropseed	*Sporobolus cryptandrus*	VNS	Warm	Bunch	0.5
Prairie Junegrass	*Koeleria macrantha*	VNS	Cool	Bunch	2.0
Muttongrass	*Poa fendleriana*	VNS	Cool	Bunch	2.0
And one of the following:					
Scarlet globemallow	*Sphaeralcea coccinea*	VNS	Warm	Forb	0.25
Utah sweetvetch	*Hedysarum boreale*	VNS	Warm	Forb	0.25

****Based on 60 pure live seeds (PLS) per square foot, drill seeded. Double this rate (120 PLS per square foot) if broadcast or hydroseeded.**

Photo 1. Pinyon-Juniper Woodland found in the Farmington Field Office.

Photo 2. Old or Persistent Pinyon-Juniper Woodland type found in the Farmington Field Office.

RECOMMENDATION FOR EFFECTIVE RECLAMATION

Recommendations: Provided below are some procedures and methods that may to help achieve more effective reclamation success.

Soil Testing: Development of a soil testing plan for evaluation of the results of topsoil handling and reclamation procedures related to revegetation may prove beneficial. Suggested soil testing may include some or all of the following: pH, electrical conductivity (EC), texture, topsoil depth and overall soil depth, carbonates (reactivity), organic matter (OM), Sodium Absorption Ratio (SAR).

Topsoil Stripping, Storage, and Replacement: At a minimum, the upper six (6) inches of topsoil should be stripped, following the removal of vegetation during construction of well pads, pipelines, roads, or other surface facilities. The stripped topsoil should be stored separately from subsoil or other excavated material and replaced prior to final seedbed preparation. Topsoil should not be used for blow pits or flaring areas.

Seedbed Preparation: For cut-and-fill slopes, initial seedbed preparation should consist of backfilling and recontouring to achieve the configuration specified in the reclamation plan. Seedbed preparation for compacted areas should be ripped to a minimum depth of eighteen (18) inches, with a maximum furrow spacing of two (2) feet. Where practicable, ripping should be conducted in two passes at perpendicular directions. **Avoid leaving large clumps or clods**. If this exists, disking should be conducted. Disking and seed drills should run perpendicular to slopes to provide terracing and prevent rapid runoff and erosion.

Seedbed preparation is one of the most important steps for reclamation success. Following final contouring, the backfilled or ripped surfaces should be covered evenly with topsoil. Final seedbed preparation should consist of raking or harrowing the spread topsoil prior to seeding to promote a firm seedbed. **A loose seedbed makes it impossible to control the depth of seeding because the tires and the planter sink into the soil.** Seedbed preparation may not be necessary for topsoil storage piles or other areas of temporary seeding.

Planting Depth: **Improper planting depth, particularly the planting of some species too deeply, in "fluffy" soils, is one of the major impediments to reseeding success.** The Truax seed drill or modified rangeland drills that allows for seeding species from different seed boxes at different planting depths has been used by other BLM offices to address this issue. Efforts should be taken to ensure that perennial grasses and shrubs are planted at the appropriate depth. Intermediate size seeds such as wheatgrasses and shrubs should be planted at a depth of 0.5 inches, larger seeds such as Indian ricegrass at 1 to 2 inches, and small seeds such as alkali sacaton, and sand dropseed should be planted at a depth of 0.25 inches. In situations where differing planting depths are not practicable with the equipment being used, the entire mix should be planted no deeper than 0.25 inch. Planting too shallow is generally better than planting too deep. **A review of current research methods is recommended (e.g., USDA PLANTS, USDA Plant Materials Centers, Native Seed Companies).**

Soil Amendments: Amending a soil is not the same thing as mulching, although many types of mulch also are used as amendments. A "soil amendment" is any material added to a soil to improve its physical properties, such as water retention, permeability, water infiltration, drainage, aeration, nutrition and structure. Organic amendments include sphagnum peat, humate, wood chips, grass clippings, straw, compost, manure, biosolids, sawdust and wood ash. Inorganic amendments include vermiculite, perlite, lime, gypsum, tire chunks, pea gravel and sand.

Mulching: Mulch may increase the success of seed germination and provide protection against erosion. Mulch should be applied within 24 hours following completion of seeding. In areas of interim reclamation that used drill-seeding or broadcast-seeding/raking, mulch shall consist of crimping certified weed-free straw or certified weed-free native grass hay into the soil. Hydromulching may be used in areas of interim reclamation where crimping is impracticable, in areas of interim reclamation that were hydroseeded, and in areas of temporary seeding regardless of seeding method. Mulch applications in extremely clayey soils should be evaluated carefully to avoid developing an adobe mixture. In these cases, a soil amendment may prove more beneficial.

Timing of Seeding: Precipitation is the principal input controlling biological processes in arid and semiarid regions. The pattern of soil moisture will have a great impact on the fate of seeding. Many grasses species will germinate following significant moisture events that allow for deeper infiltration of soil moisture (4-12 inches deep). This moisture generally persists for several weeks and is available for seedling root growth and establishment.

Grass species belong to one of two basic physiological types; cool season or warm season. Cool season grasses have optimum growth temperatures of 70-75°F with growth halting at around 40°F. Warm season optimum temperatures occur at 85-95°F and growth ceasing at about 55°F. The best time for seeding grass is at the beginning of the growing season. For cool season grasses, there are two growing cycles: FALL and SPRING. The best time to plant cool season grasses is in late summer or early fall. For warm season grasses, there is 1 growing season: SUMMER. The best time plant warm season grass species is early spring or summer, with the onset of the monsoons, typically beginning in early to mid-July.

The paragraph above provides the optimal timings of seeding for cool and warm season species which make up the seed mixes for of the eight desired plant communities for reclaiming disturbed areas. Experience in Farmington Field Office has shown with adequate winter moisture seeds planted in the late fall or early winter (before the ground is frozen), that cool season species will germinate the following spring, setting the stage for germination of warm season species in the mix later in the season.

Additional Seeding Rates or Species: While minimum seed requirements have been provided by the BLM, it does not exclude proposals for increased seeding rates or additional species/varieties of plants to BLM for approval to achieve reclamation standards. Industry attaining an understanding of soil types, precipitation patterns, the climate, and vegetation/environment relationships could be very valuable.

Sterile Cover Crop Option: Sterile cover crops can be useful in temporary site stabilization in the case where bare soil is exposed. It also can be used with the perennial mix in reclamation for a non-persistent "nurse" crop. A nurse crop is an annual crop used to assist in establishment of a perennial crop. Nurse crops reduce the incidence of weeds, prevent erosion, and shelter tender seedlings from sun and wind.

Other advantages are:

- Sterile annual plant; rapid germination (sprout rapidly, establish quickly)
- Plant will not persist past one growing season
- Cold tolerant, able to grow under cool conditions
- Larger root mass and more efficient use of soil nutrients than wheat; holds soil and builds soil organic matter
- Superior tolerance to disease, salt, and drought compared to wheat
- Able to adapt to a wide range of soil and moisture conditions
- Adapts either fall or spring plantings; has fair to excellent winter survival

Common Name	Scientific Names	Variety	Season	Form	PLS lbs/acre*
Sterile Cover Crop	*Triticum aestivum X Secale cereale*	Quickguard or similar sterile hybrid var.	Cool	Grass	7-10

***Based on 60 pure live seeds (PLS) per square foot, drill seeded. Double this rate (120 PLS per square foot) if broadcast or hydroseeded. Can be mixed with the perennial mix and seeded at the same time.**

BLM Consultation: BLM is available provide consultations concerning fencing options to help minimize industry costs, should fencing be necessary to achieve reclamation success.